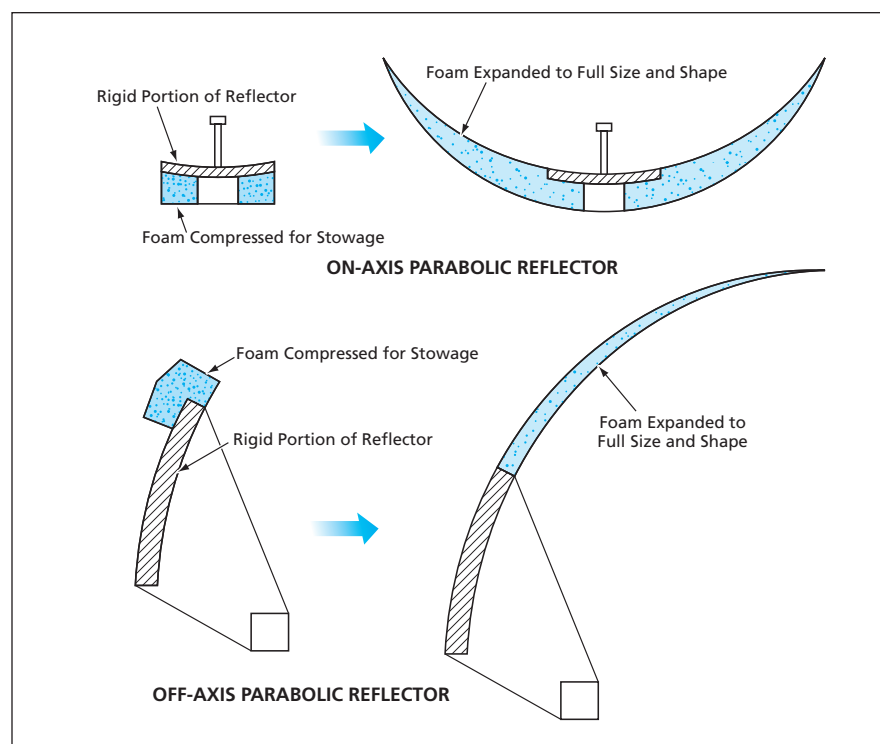


should exceed that of other materials.

- In its macroscopic mechanical properties, an open-cell foam is isotropic. This isotropy facilitates computational modeling of antenna structures.
- Through chemical formulation, the T_g of an open-cell polyurethane foam can be set at a desired value between about -100 and about 0 °C. Depending on the application, it may or may not be necessary to rigidify a foam structure after deployment. If rigidification is necessary, then the T_g of the foam can be tailored to exceed the temperature of the deployment environment, in conjunction with providing a heater to elasticize the foam for deployment. Once deployed, the foam would become rigidified by cooling to below T_g .
- Techniques for molding or machining polymeric foams (especially including open-cell polyurethane foams) to desired sizes and shapes are well developed.

This work was done by Tommaso Rivellini, Paul Willis, Richard Hodges, and Suzanne Spitz of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-30819



These On- and Off-Axis Parabolic Reflectors are two examples of antenna reflectors that would include rigid narrow apertures and adjoining deployable foam-supported wider apertures.

Coating MCPs With AlN and GaN

Emission of electrons is increased.

Goddard Space Flight Center, Greenbelt, Maryland

A development effort underway at the time of reporting the information for this article is devoted to increasing the sensitivity of microchannel plates (MCPs) as detectors of photons and ions by coating the MCPs with nitrides of elements in period III of the periodic table. Conventional MCPs are relatively insensitive to slowly moving, large-mass ions — for example, ions of biomolecules under analysis in mass spectrometers. The idea underlying this development is to coat an MCP to reduce its work function (decrease its electron affinity) in order to increase both (1) the emission of electrons in response to impingement of low-energy, large-mass ions and (2) the multiplying effect of secondary electron emission.

Of particular interest as coating materials having appropriately low or even negative electron affinities are gallium nitride, aluminum nitride, and ternary alloys of general composition $\text{Al}_x\text{Ga}_{1-x}\text{N}$ (where $0 < x < 1$). These materials exhibit attractively high degrees of chemical, mechanical, and thermal stability plus

acceptably high resistance to sputtering. The electron-excitation cross sections of these materials are expected to exceed those of several other materials (including diamond) that are, variously, in use or under development for the same purpose. Moreover, by doping these materials with silicon, one can render them partly electrically conductive, thereby suppressing the undesired accumulation of electric charge that could otherwise occur during bombardment by ions.

For experiments, thin films of AlN and GaN — both undoped and doped with Si — were deposited on commercial MCPs by radio-frequency molecular-beam epitaxy (also known as plasma-assisted molecular-beam epitaxy) at temperatures < 200 °C. This deposition technique is particularly suitable because (1) MCPs cannot withstand the higher deposition-substrate temperatures used to decompose constituent compounds in some other deposition techniques and (2) in this technique, the constituent Al, Ga, and N are sup-

plied in elemental form, so that there is no need for thermal decomposition at the substrate surface. The nitride films thus formed were, variously, amorphous or polycrystalline. The nitride films were coated with surface layers of gold < 100 Å thick.

The MCPs were tested in a standard configuration in which the output stage of a first MCP was coupled to the input stage of a second MCP. Each pair of MCPs was mounted in a standard holder that included front and back contact rings and an anode for collecting the output electrons of the second MCP. The MCP pairs were biased at potentials between 1.7 and 1.9 kV, and count rates measured after preamplification and discrimination. To enable a direct comparison, in one pair, the second MCP was uncoated while the first MCP was coated over half its surface. The coated and uncoated sides of the half-coated MCP were exposed to fluxes of argon ions at kinetic energies of 1.0 and 0.5 keV. At 1.0 keV, the count rate for the coated side was about 2.3 times greater than

that for the uncoated side; at 0.5 keV, the count rate for the coated side was about 1.8 times greater than that for the uncoated side.

This work was done by Abdelhakim Bensaula, David Starikov, and Chris Boney of Integrated Micro Sensors, Inc. and Abdelhak Bensaula of the University of Houston

*for Goddard Space Flight Center. Further information is contained in a TSP (see page 1).
GSC-14936-1*

Domed, 40-cm-Diameter Ion Optics for an Ion Thruster

A modified design affords better performance without loss of service life.

John H. Glenn Research Center, Cleveland, Ohio

Improved accelerator and screen grids for an ion accelerator have been designed and tested in a continuing effort to increase the sustainable power and thrust at the high end of the accelerator throttling range. The accelerator and screen grids are undergoing development for intended use as NASA's Evolutionary Xenon Thruster (NEXT) — a spacecraft thruster that would have an input-power throttling range of 1.2 to 6.9 kW. The improved accelerator and screen grids could also be incorporated into ion accelerators used in such industrial processes as ion implantation and ion milling.

NEXT is a successor to the NASA Solar Electric Propulsion Technology Application Readiness (NSTAR) thruster — a state-of-the-art ion thruster characterized by, among other things, a beam-extraction diameter of 28 cm, a span-to-gap ratio (defined as this diameter divided by the distance between the grids) of about 430, and a rated peak input power of 2.3 kW. To enable the NEXT thruster to operate at the required higher peak power, the beam-extraction diameter was increased to 40 cm — almost doubling the beam-extraction area over that of NSTAR (see figure). The span-to-gap ratio was increased to 600 to enable throttling to the low end of the required input-power range.

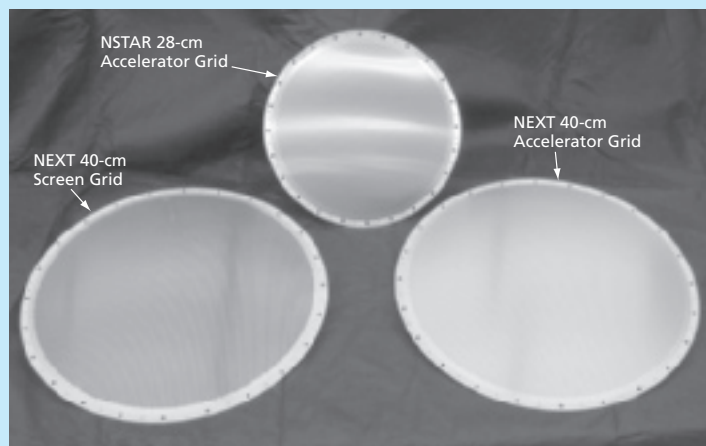
The geometry of the apertures in the grids was selected on the basis of experience in the use of grids of similar geometry in the NSTAR thruster. Characteristics of the aperture geometry include a high open-area fraction in the screen grid to reduce discharge losses and a low open-area fraction in the accelerator grid to reduce losses of electrically neutral gas atoms or molecules. The NEXT accelerator grid was made thicker than that of the NSTAR to make more material available for erosion, thereby increasing the service life and, hence, the total impulse.

The NEXT grids are made of molybdenum, which was chosen because its combination of high strength and low

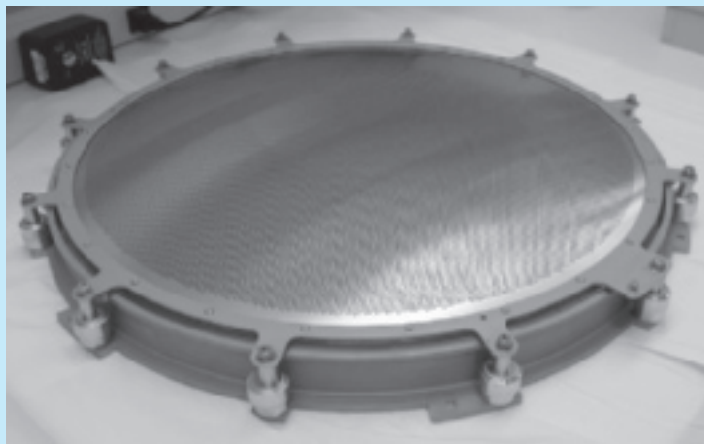
thermal expansion helps to minimize thermally and inertially induced deflections of the grids. A secondary reason for choosing molybdenum is the availability of a large database for this material. To keep development costs low, the NEXT grids have been fabricated by the same techniques used to fabricate the NSTAR grids. In tests, the NEXT ion optics have been found to outperform the NSTAR ion optics, as expected.

This work was done by George C. Soulas, Thomas W. Haag, and Michael J. Patterson of Glenn Research Center. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Commercial Technology Office, Attn: Steve Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17598-1.



Comparative View of 28- and 40-cm Grids



40-cm Grids Installed in Ion-Optics Assembly

The NEXT 40-cm Grids are dome-shaped as are the 28-cm NSTAR grids.